

## **Historic, Archive Document**

Do not assume content reflects current scientific knowledge, policies, or practices.



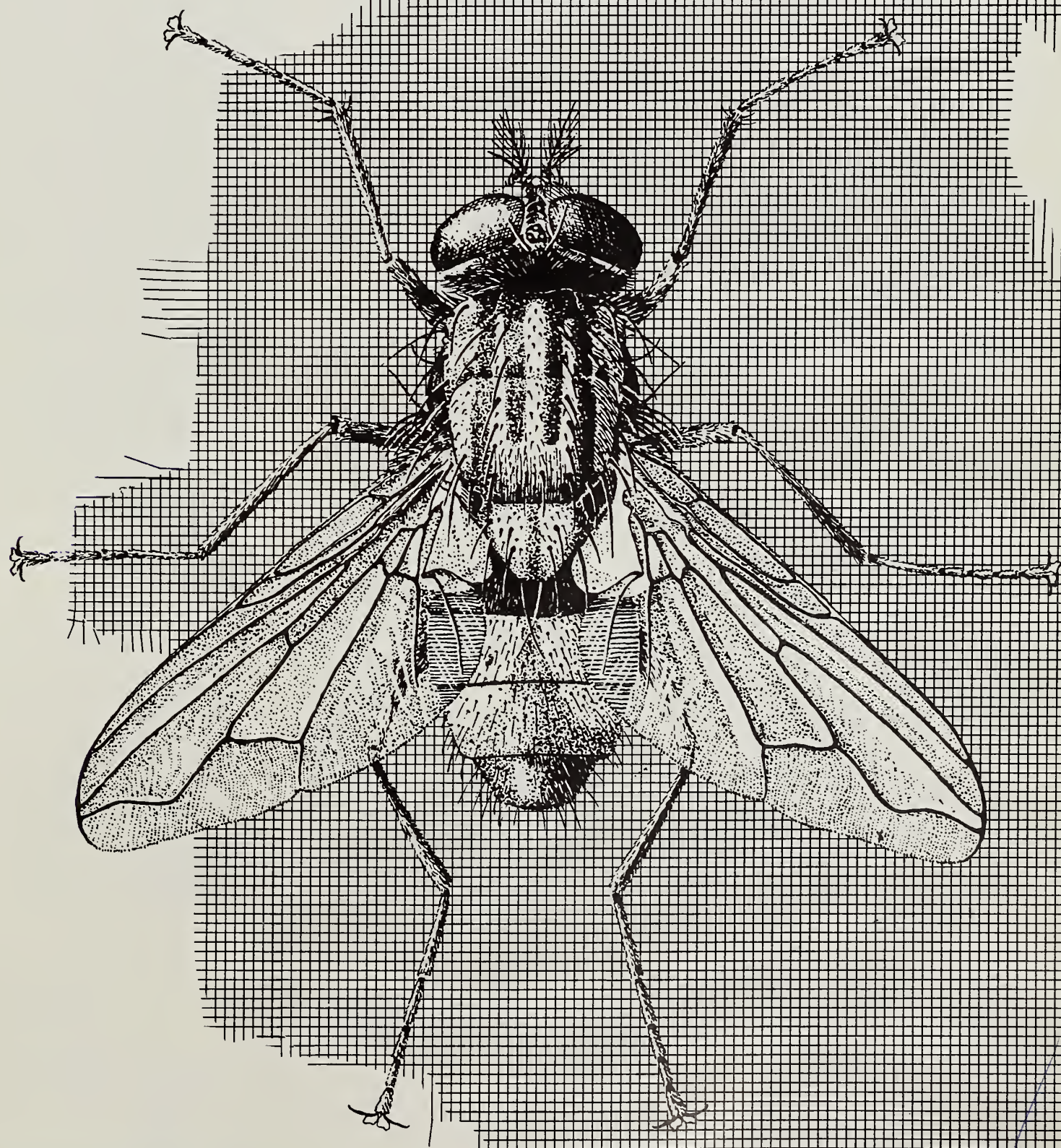


# agricultural research

U.S. DEPARTMENT OF AGRICULTURE

MARCH 1973

*Vol. 21 (9)*





# agricultural research

March 1973/Vol. 21, No. 9

## The Beefmakers

To many Americans the word *beef* conjures up images of the unfenced range, the roundup, the cowboy. These are images that TV and motion pictures have kept alive long after the last great trail herd followed the buffalo beyond the horizon late in the last century. In those epic days contemporaries were awed by the long lines of Texas longhorns coming up over a rise in the prairie, dust-caked and gaunt, so eager to break from the control of cowboys strung out along the flanks of the herd. Perhaps the cattle drives from lower Texas up the Chisholm Trail to flourishing cattle towns in Kansas best epitomized the Old West.

Time inexorably brings changes. The cattle boom reached its zenith in the decade of 1880, but was soon beset by disasters: overspeculation, falling prices, and cattle-killing blizzards. Along with these upheavals, the very basis of the trail herd business—the open range—was rapidly coming under fence, and the longhorn was giving way to better and heavier stock. Frontier individualism surrendered to economic necessity.

Compared to his legendary predecessor, today's cattleman may cut a less colorful figure but he is a far superior producer of beef. To be successful, the modern cattleman must master many technical skills, know management, and draw upon new developments in animal science. ARS scientists have long engaged in multi-faceted research to help cattlemen—whether breeder, rancher, or feeder—produce more and better beef for a growing population. For example, they pioneered in research on the requirements for certain vitamin and mineral supplements, and on the efficient feeding of non-protein materials as substitutes for expensive protein. They developed methods of performance testing to gauge the genetic worth of herd sires. And they devised better systems of cross-breeding to produce bigger crops of growthier calves.

In recent years much ARS research has been directed to improving the reproductive efficiency of beef cattle. Too many brood cows, for example, fail to come into heat, fail to conceive, or abort. Other related problems involve difficult calving, and the high losses of calves just before and after birth. To improve the efficiency of artificial insemination under range conditions, scientists are testing chemicals that induce estrous so that many cows can be bred over a short time span.

Cattle raising has been a human activity for thousands of years. Its practice is ever changing to meet the dictates of new conditions, but science will help beef hold its esteemed place on the national menu.

## ANIMAL SCIENCE

- 6 The secret of fetal immunity
- 10 Leaner broilers through genetics
- 12 Breaking the liver fluke cycle

## ENVIRONMENT

- 3 Recovering heavy metals
- 14 Morrison lecture

## INSECT

- 8 A better attractant for houseflies
- 13 Pollen cakes save the bees

## PLANT SCIENCE

- 10 Maple sirup from West Virginia?

## NUTRITION

- 5 Convenience foods from corn-soya?
- 11 Enriching the food we eat

## AGRISEARCH NOTES

- 15 Drying raisins faster
- 15 Maple syrup from West Virginia?
- 15 Quick test for acid
- 16 Early weaning/more calves

*Editor: R. P. Kaniuka*

*Editorial Assistant: M. J. Phillips*

## Contributors to this issue:

*R. C. Bjork, M. C. Guilford,  
G. B. Hardin, D. H. Mayberry,  
M. E. Nicholas, R. G. Pierce,  
N. E. Roberts, D. H. Senft,  
D. M. Webb*

---

**COVER:** Muscalure more than triples the response of house flies to several traps and baits used against these disease-bearing pests (EDQ-4076). See story on p. 8.

---

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), U.S. Department of Agriculture, Washington, D.C. 20250. Printing approved by the Office of Management and Budget through June 15, 1977. Yearly subscription rate is \$2.50 in the United States and countries of the Postal Union, \$3.25 elsewhere. Single copies are 30 cents. Send subscription orders to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Use of commercial names and brands is for identification only and does not imply endorsement or approval by USDA or ARS. Information in this magazine is public property and may be reprinted without permission. Credit will be appreciated but is not required. Prints of photos are available to mass media; please order by photo number.

Earl L. Butz, Secretary  
U.S. Department of Agriculture

Talcott W. Edminster, Administrator  
Agricultural Research Service

## Recovering heavy metals

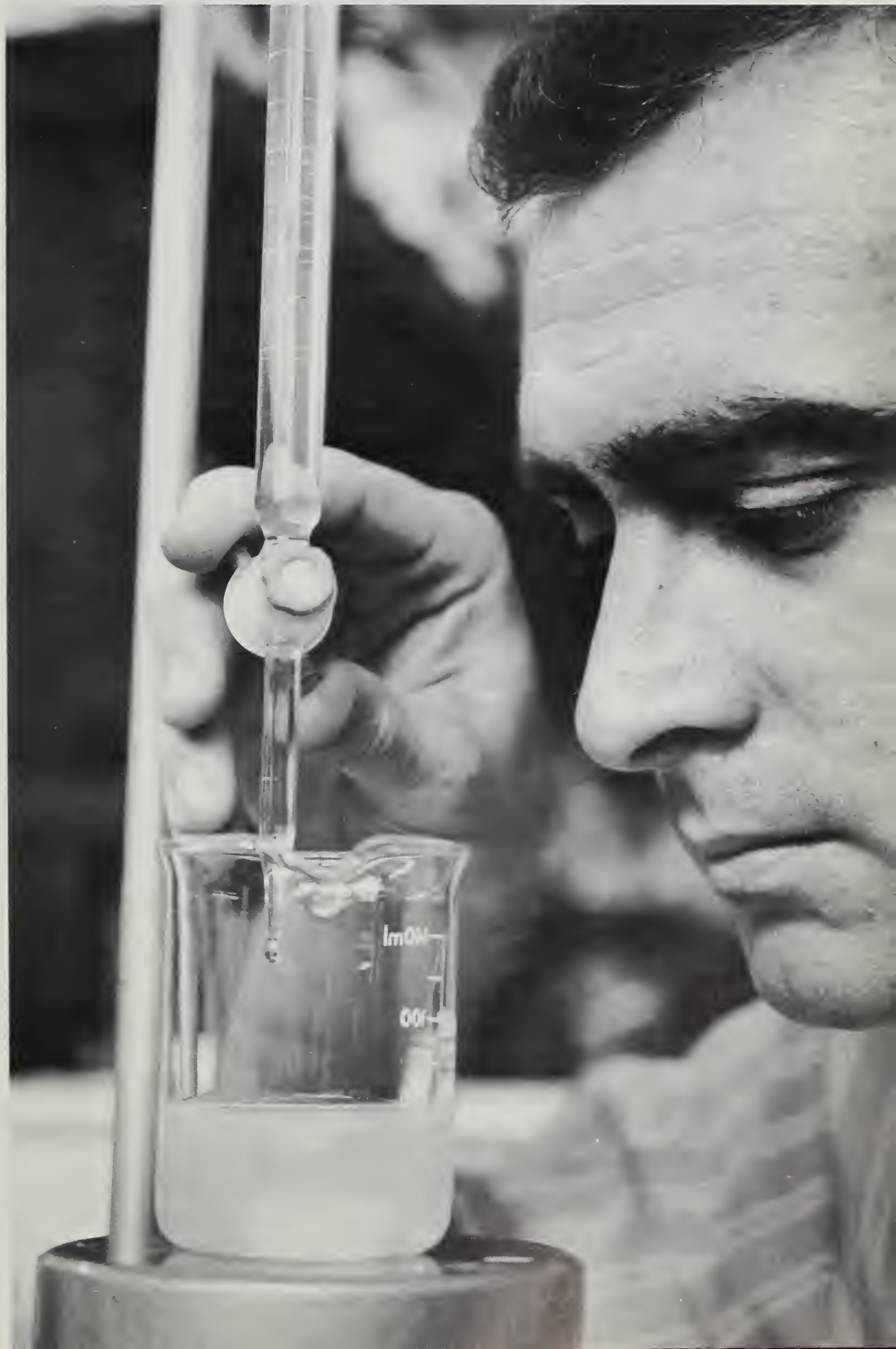
A STARCH COMPOUND makes the better half of a chemical marriage of two polymers that recover mercury and other valuable metals from water they pollute.

ARS scientists have found that starch xanthate unites with certain cationic polymers to precipitate the metals so

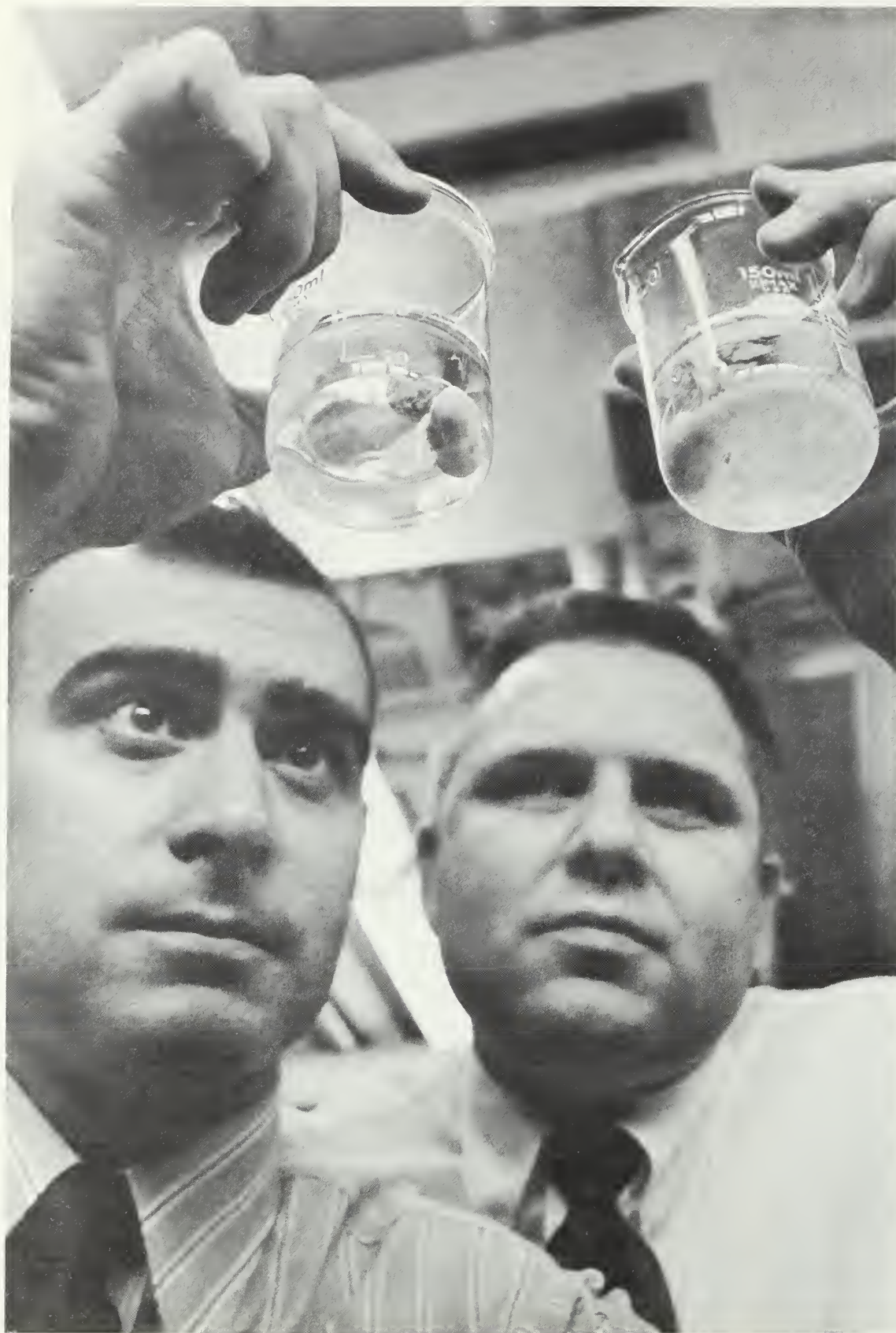
they can be recovered from water. The method recovers silver, chromium, cadmium, copper, lead, nickel, zinc, iron and manganese in addition to mercury.

These metals in water represent loss of valuable materials. Some of them, furthermore, can reach toxic levels and pollute water even though trace levels

*In metal recovery research, through titration, Dr. Wing adds specific amounts of starch xanthate to mercury-contaminated water. Cloudiness is caused by the mercury-bearing precipitate (1072X1410-3).*







*Dr. Wing and Mr. Swanson compare beakers containing purified water with mercury in a coagulated precipitate (left) and in a flocculant precipitate (right). Precipitate form can be varied in the process (1072X1410-32).*

are required in plant and animal nutrition. Even low levels of mercury can be toxic.

The method, developed by Charles L. Swanson, Robert E. Wing, William M. Doane and Charles R. Russell, Northern laboratory, Peoria, precipitates metals

from water solutions too dilute for practical treatment by other methods. It is more effective on higher concentrations, and will not precipitate carbon-metal compounds like methyl mercury. These compounds would have to be broken down chemically before

the metal ions could be precipitated.

From a concentration of 100,000 parts of mercury per billion parts of water (ppb), for example, 99,996.2 ppb of mercury is recovered in one treatment with the present marriage of starch xanthate-cationic polymer. Successive treatments would recover part of the 3.8 ppb of mercury remaining after one treatment.

Several different recovery combinations using starch xanthate are under study to find those that are lowest in cost and most efficient. Using the projected cost of materials, the treatment of mercury-containing wastes pays for itself by recovering the mercury which is removed.

In addition, there is a high rate of recovery. The 3.8 ppb of mercury remaining after single treatment is within tentative U.S. Standards for drinking water, although above some State proposals. Single treatments of separate solutions containing copper, lead, chromium, cadmium, nickel, and silver also resulted in metal residues lower than the most stringent State or Federal standards now proposed. Residual levels of zinc, iron, and manganese, on the other hand, exceeded proposed standards.

Starch xanthate treatment can be adjusted to a wide variety of industrial effluents and pollution problems not tested in the laboratory studies. Adjustments would include level and selection of cationic polymer, rate of adding starch xanthate, effluent pH, and increasing the number of treatments.

The metal-recovery method grew out of research on cereal xanthate now undergoing pre-industrial development as an additive to increase strength in paper and rubber.

Starch for making starch xanthate can be obtained from any cereal grain. Most starch xanthate is made from corn starch because it is most plentiful and lowest priced. □



# Convenience foods from corn-soya?

**I**N THE LAST DECADE, blends of corn and soybean products have been developed for nutritionally balanced human foods. Few corn-soya products, however, have been commercially attractive enough for private firms to undertake production and promotion for domestic use.

CSM (corn, soy flour, nonfat dry milk) mix is distributed extensively to critically hungry children through the United Nations Children's Fund and other relief agencies (AGR. RES. Apr. 1971, p. 3).

In recent research by chemical engineers Howard F. Conway and Roy A. Anderson at the ARS Northern regional research laboratory, Peoria, Ill., a variety of corn-soya products and other cereal-soya blends were formulated, cooked by a direct extrusion process, and evaluated for flavor and physical characteristics. Many of these blends may have potential as economical convenience foods with taste appeal.

A cooker-extruder uses the same working principles found in pressure cookers and sausage grinders. A screw pushes the blend through a high pressure section of a hollow cylinder where the temperature of the meal exceeds that of the atmospheric boiling point for water. No moisture is evaporated until pressure is released as the product goes through small holes of a die.

Corn-soya blends can be fortified with vitamins and minerals, and flavored or seasoned for direct consumption as snack foods or breakfast foods. The blends have further potential as ingredients in gravies, cookies, breads, soups, and other foods. Development of these foods with coordination by food technologists, nutritionists, and marketers could result in widespread stocking of the foods on store shelves.

The ARS engineers studied the expansion or puffing properties of various cereal-soya blends. Degree of expansion affects density, friability, and tenderness which are important in con-

*Yards of corn-soya curls are produced from relatively small amounts of blended meal. Here, engineer Howard F. Conway feeds the cooker-extruder used in the research project (1072X1411-1).*

sidering potential product applications. Expansion was expressed as diameter of the extruded product divided by the diameter of holes in the extruder's die.

The cereal standard, yellow corn snack meal, had an expansion of 4 and only one blend had a larger expansion. That blend was 90 percent yellow snack meal and 10 percent vital wheat gluten. Yellow corn snack meal is a commercial product consisting of horny endosperm particles of yellow corn. It is used for the production of corn curls. While wheat gluten tended to increase expansion values, soy products tended to decrease them. More refined soy products, such as the isolate and concentrate, imparted better expansion properties than did soy flakes or soy flour.

Most cooked blends carried the flavor of the cereal component. When as much

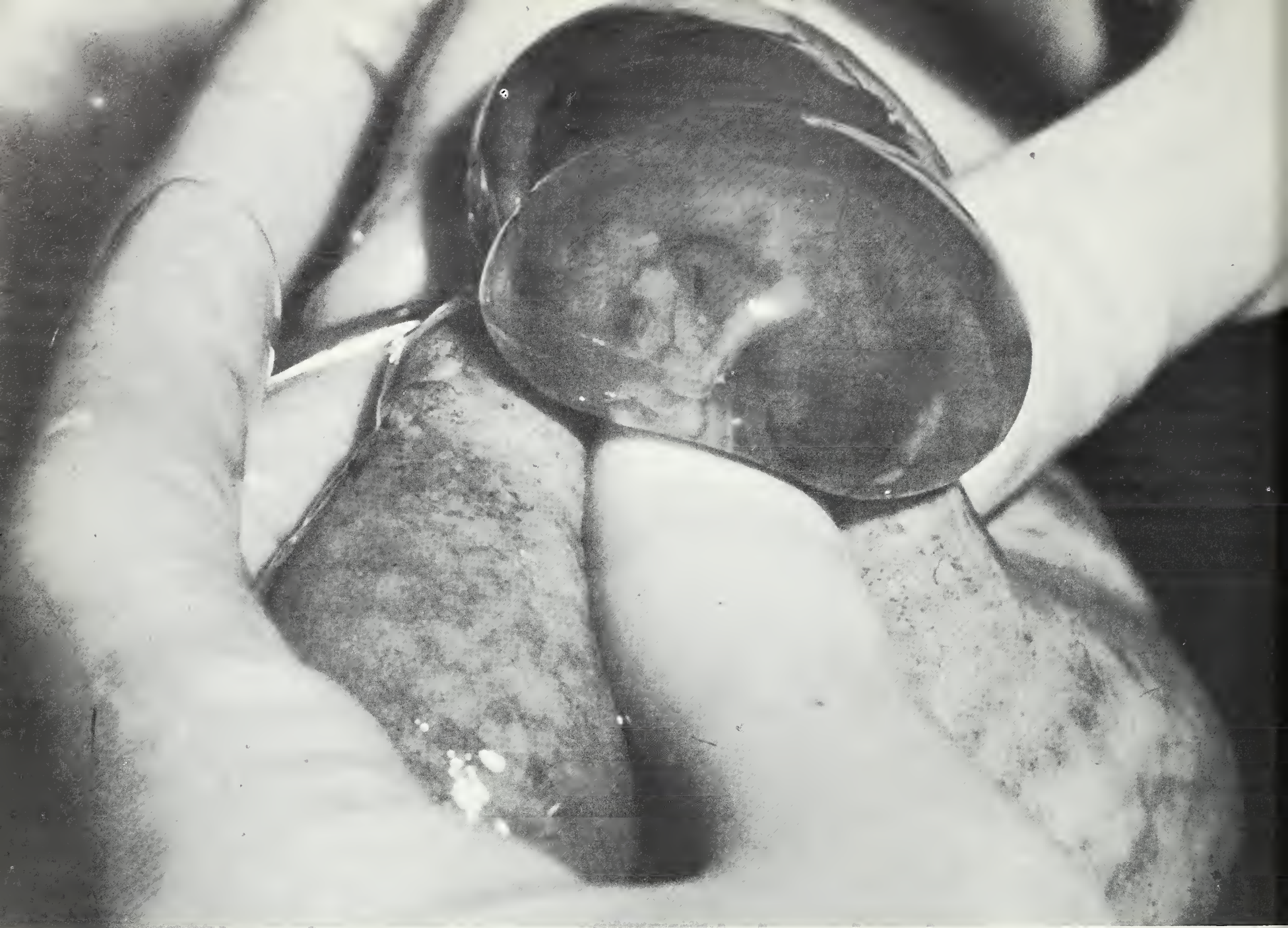
as 40 percent of the mixture was soy flakes, the cereal taste still dominated although the soy flavor was starting to come through. Seasonings and flavorings could be added to the blends to differentiate products for a variety of consumer tastes.

A computer chose compositions of three component blends based on variance of ratios of each of eight essential amino acids (EAA's) in the components to EAA's in hen's egg protein. The World Health Organization has described hen's egg protein as having the best proportion of EAA's for human nutrition.

Any protein of good quality should contain all the EAA's biologically available in adequate quantities, when eaten. Excessive amounts of any one of these may be wasteful or even detrimental. □







*One of these twin fetuses was injected with a protein substance after removal from the uterus on the 35th day of development. Six days later, both fetuses were removed again and blood tests made to compare antibody development (PN-2832).*

## Probing the secrets of fetal immunity

**S**TUDIES of fetal lambs are leading to a better understanding of how disease affects sheep and other mammals before birth.

Through operations on unborn lambs, cooperating scientists of ARS and the Johns Hopkins School of Medicine, Baltimore, Md., are clearing up some of the mysteries of fetal immunity. Their new knowledge is explaining how disease affects fetal lambs at different stages of growth, and why birth defects result from certain diseases.

Until about 15 years ago, scientists generally thought that an unborn lamb could not be removed from the uterus and operated on without major problems. But over the past decade, chemist Arthur M. Silverstein of Johns Hopkins, working with ARS scientists led by geneticist Clair E. Terrill, of Beltsville, Md., has been proving that operations on fetal lambs are not only possible, but practical and medically significant.

Dr. Silverstein performs the operations on the unborn lambs, carefully re-

moving them from the uterus and replacing them when the operation is completed. As many as five operations are made to observe a single fetus. Later, the lamb is born naturally 150 days after conception. More than 400 ewes have been operated on in the course of these experiments.

During an operation, Dr. Silverstein may graft a section of skin onto the fetal lamb. The skin may come from the lamb's twin, from the lamb's own body, or from the ewe. These grafts permit



study of the rate of acceptance or rejection by the lamb's body. Dr. Silverstein also injects disease organisms or other antigens (substances which stimulate the formation of antibodies) into the lamb to monitor the formation of antibodies.

At Beltsville, scientists care for and breed ewes, noting the breeding date to pinpoint the exact age of the fetus. Many experiments in immunology would otherwise not be significant, because the immune mechanism in fetal lambs largely depends on age.

Sheep have several qualities that make them ideal for these operations—they are medium-sized animals and easily handled. Moreover, antibodies do not cross the placenta from ewe to lamb or vice versa, thus their respective antibodies can be distinguished. Finally, ewes often have twins, which makes it easy to judge the effectiveness of operations by keeping one twin as a control.

Dr. Silverstein's work has shown that fetal lambs produce antibodies in a stepwise pattern. When a fetal lamb reaches a certain age, say 52 days, it

will be able thereafter, but not before, to produce antibodies to a particular antigen. The ability to respond immunologically to each of various antigens arises at a fixed age in the lamb's development. The entire developmental process seems to be under precise control and identical in all fetal lambs.

The assumption that ability to form antibodies develops at the same rate as the animal's lymphoid tissues (which are responsible for production of antibodies) has been proved false as a result of Dr. Silverstein's work. He has shown that development of the lamb's ability to manufacture antibodies has no relationship to its increase in lymphoid cells, a finding of great significance to immunologic theory.

Studies on the relationship of the thymus gland to immunity in fetal lambs have led to some of Dr. Silverstein's most important discoveries. The thymus is thought to regulate the maturation of lymph cells. But even if this gland is removed from a fetal lamb, the process of building antibodies continues in its natural sequence.

If the thymus is removed and the re-

maining lymphoid cells destroyed in a fetal lamb, the lamb will be born with only a few lymphoid cells. Within a month or two after birth, however, the level of circulating lymphoid cells rises again, and the lamb will then show the same ability as a normal lamb to form antibodies against antigens.

These and other studies on congenital infections in the fetus provide important basic knowledge for the sheep industry. A better understanding is now possible of how vaccines affect the fetus. The research helps to explain, for example, why, at one stage of pregnancy, a vaccinated ewe will have a deformed lamb, while at a later stage vaccination will not affect the fetus. This research may also help in understanding how fetal disease develops at different ages, and how disease organisms may be influenced by the fetus and made either more or less potent.

Dr. Silverstein's discoveries have thus opened up new possibilities for the study of immunology in all mammals. This cooperation between ARS and Johns Hopkins is advancing both veterinary and medical science. □

*Left: Rear of this 107-day old fetus has two skin grafts—one from its own body, left, and one from an adult ewe, right. The graft from the fetus' own body has been accepted and is almost invisible except for the sutures. The other graft is in an advanced stage of rejection. Fetal ability to reject grafts begins at about 80 days of age (PN-2833). Right: Pregnant ewes from Beltsville are urged up ramp and into truck headed for Johns Hopkins (173X45-10).*







# A better attractant for ho

***Above left:** Biological technician John Morgan, Jr., separates house flies obtained in the field in muscalure baited traps. If large numbers of flies are caught during one test, he separates 100 flies, determines the percentage of females, then weighs them to obtain a total count (PN-2830).*

***Above right:** Dr. Carlson examines treated and untreated fly paper strips after 24 hours exposure in the field. Strip treated with muscalure is on the right; it captured 430 house flies. The untreated strip captured 123 flies (PN-2829).*

***Right:** Dr. Carlson places an electric grid trap on the floor of a pen next to a pen containing sheep. The pan under the grid is baited with 10 milligrams of muscalure. After a 24-hour exposure, the trap captured 9,970 house flies (PN-2828).*







se flies



**M**USCALURE, an attractant for house flies, may substantially reduce the need for insecticides. Initial ARS field tests show that muscalure more than triples the response of house flies to several traps and baits now used against these disease-bearing pests.

Chemists David A. Carlson, Gainesville, Fla., and Morton Beroza, Beltsville, Md., collaborated in developing muscalure, which originally appeared to act as a sex attractant for male house flies. Field tests have now shown that muscalure attracts both sexes.

Dr. Carlson tested pairs of baited and unbaited traps in hog, horse, and sheep barns in Florida. The results have implications for poultry houses, dairy barns, homes, or other places infested by flies. Three to twelve times more flies responded to traps baited with muscalure than to unbaited traps. In 24-hour exposures in heavily infested barns, the baited traps caught flies in the presence of other natural attractants: female flies, animal feed, and manure. Dr. Carlson applied 0.5 to 100 milligrams of muscalure to 1 milliliter of ground corncobs having a consistency of coarse sand. Unlike some malodorous baits, muscalure is a clear, odorless oil.

Muscalure attracted the greatest number of flies in electric grid traps placed 15 feet apart on barn floors. A pan under the grids contained muscalure-impregnated corncob granules. In efforts to reach the granules, an average of 6,000 flies landed on the wires of the grid and were electrocuted, compared to about 350 in the control trap without muscalure.

Dr. Carlson also tested a commercial, granular fly bait containing dichlorvos

and trichlorfon. He treated this bait with muscalure and placed it in small pans on the ground. After 24 hours, pans of treated bait contained an average of 1,000 dead flies, seven times more than the pans without muscalure.

A third series of tests was made with commercial flypaper strips hung 10 feet above the ground. Strips treated with muscalure captured an average of 391 flies, three times more than the plain strip.

In experiments with 1-foot square adhesive-coated Formica panels, treated panels captured an average of 251 flies, three times more than the plain panels.

A few stable flies also were captured by various traps. However, large numbers of unwanted species were not attracted to the traps.

The number of house flies captured in the Florida tests partly demonstrates differences in the ability of the traps to prevent the insects from escaping after they are attracted by muscalure. Thus, the electric grid traps may have captured the most flies because the insects were electrocuted on contact. Some flies may have escaped from the granule bait and sticky traps.

In laboratory experiments, only males were attracted to muscalure. In contrast, about equal numbers of both sexes responded to traps baited with muscalure in barns. Thus, the ability of muscalure to attract both sexes enhances its potential usefulness.

Dr. Carlson, Dr. Beroza, and chemist Robert E. Doolittle also studied the attractancy of chemically similar forms of muscalure called isomers, and found that several of these isomers effectively attracted house flies. Further studies will be made with these isomers. □



## Leaner broilers through genetics

**G**ENETIC DIFFERENCE may provide a key to reducing abdominal fat in broilers, thus making them more attractive to housewives and more efficient for producers.

Abdominal fat increases the price of

broilers by adding weight to the carcass—a fact that makes housewives unhappy, since most discard this fat. It is no advantage to producers, either, since more than twice as much food energy is needed to produce fat as to produce lean meat.

Scientists at ARS' Poultry Research Laboratory, Georgetown, Del., believe they have found a partial solution to this problem. Their research shows that the amount of abdominal fat varies among different strains of broilers—groups of birds of the same breed that differ slightly in genetic makeup. Strains are developed to meet specific needs—for example, a strain may be resistant to a certain disease.

To test for strain differences in ab-

dominal fat, poultry scientist Lloyd H. Littlefield at Georgetown selected 20 male chicks from each of 4 broiler strains. The chicks were placed in pens and fed a commercial starter and finisher diet. At eight weeks of age the birds were slaughtered and examined.

Among the strains, there was a significant difference in the percentage of abdominal fat in proportion to body weight. Fortunately, the broilers with the lowest fat percentage had the highest feed efficiency. Those with the highest percentage of abdominal fat had the lowest feed efficiency.

Dr. Littlefield concludes that strain differences may pave the way for genetically reducing the amount of abdominal fat in broilers. □

## Blueberries respond to root treatments

**P**ROPAGATION of highbush blueberry cuttings has been enhanced by applying experimental rooting compounds to some varieties.

ARS horticulturist John W. Hull and horticulturist Gerald D. Coorts, Southern Illinois University, both at Carbondale, Ill., evaluated rooting of hardwood and softwood cuttings of Bluecrop, Blueray, Coville, and Stanley cultivars.

Hardwood cuttings were taken in February (dormant) and March (buds swell). Softwood cuttings were taken about once a month, May through August. Rather than observing calendar dates precisely, the horticulturists took the cuttings according to stage of growth. All cuttings were given four different basal stem treatments.

The following treatments were used at each period: 0.8 percent indole-3-butyric acid (Treatment No. 1); 0.8 percent indole-3-butyric acid and 15 percent tetramethylthiuram disulfide

(Treatment No. 2); 0.4 percent alpha-naphthalene acetamide (Treatment No. 3); 0.5 percent indole-3-butyric acid, 0.5 percent naphthaleneacetic acid, 0.01 percent phenylmercuric acetate, and 0.0175 percent boron (Treatment No. 4); and control (no treatment).

The cuttings were planted in a medium of equal volumes of sphagnum peat and perlite and placed under intermittent mist.

Greatest rooting of the Bluecrop cultivar appeared on February cuttings with Treatment No. 1. Hardwood cuttings of other cultivars, however, had better rooting responses in March cuttings. Of these, Blueray and Stanley cuttings responded best with Treatment No. 2. None of the compounds increased rooting of the Coville hardwood cuttings.

When softwood cuttings were propagated, the researchers obtained significantly higher rooting response for

all cultivars from May cuttings with their early flush of growth. May cuttings of Bluecrop and Blueray rooted best in response to Treatment No. 2 while Stanley and Coville rooted best with Treatment No. 1.

A marked rooting response was obtained with Treatment No. 4 on Bluecrop cuttings taken in June.

Pooled data showed that generally Treatment No. 4 gave significantly poorer response than any other treatment. Often this treatment even inhibited rooting. Generally Treatment No. 2 gave better rooting results than all other basal treatments, and Treatment No. 3 results were not significantly different from the controls.

These chemicals are not registered for the use tested in these experiments. All uses of these chemicals must undergo stringent tests by its manufacturer and then be registered by the appropriate State and Federal agencies before they can be recommended. □



# Enriching the food we eat

**T**HE FAMILY of traditional U.S. foods from corn, including meal and grits, has a new addition. It is corn germ flour, which comes from one of the best parts of the kernel and can serve to enrich a variety of foods with protein and minerals.

Almost 130 million bushels of white and yellow corn are dry-milled to corn flour, meal, and grits every year. The germ is separated and processed for oil. The residual is sold for livestock feed.

Cereal chemists at the Northern regional research laboratory, Peoria, Ill., made dry-milled corn germ meal and evaluated it in cookies, muffins and beef patties. They analyzed the cream-colored flour and foods made with it for protein and amino acids as well as for minerals and other nutrients.

Cookies, muffins, and patties were found acceptable in flavor, odor, and color by a 10-member taste panel. The panel found no objectionable corn flavor in the cookies or in the muffins.

By replacing 25 percent of the all-purpose wheat flour in cookies with the corn germ flour, the chemists doubled the levels of amino acids, lysine and tryptophan, and of iron. Phosphorus and potassium levels increased about seven times and magnesium, tenfold.

Germ flour also enriched muffins by adding phosphorus, potassium, magnesium and iron, but the enrichment was not as great as in cookies. The control muffins, unlike the cookies, contained baking powder, eggs and milk.

The addition of corn germ flour to uncooked ground beef, 5 percent by

weight, increased the weight of broiled patties by more than 7 percent. One hundred grams of uncooked beef alone yielded 70 grams of broiled patty. In contrast, 95 grams of beef plus 5 grams of germ flour yielded 75.2 grams of broiled patty. The 70-gram beef patty contained 20.4 grams—29 percent protein; the 75-gram corn germ beef patty contained 19.5 grams—26 percent protein. Fat content was reduced but the levels of fiber, phosphorus, potassium, magnesium, and iron were increased.

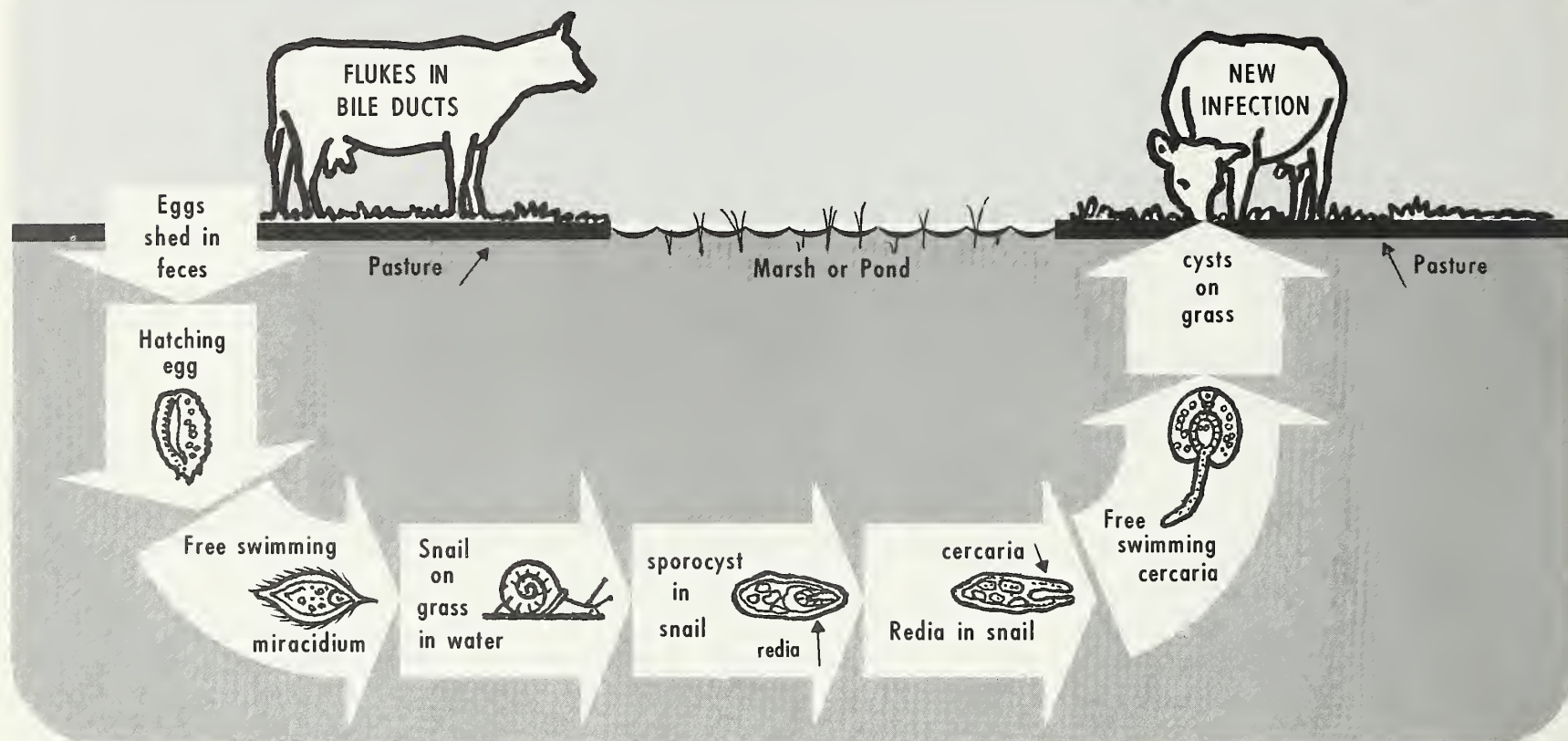
Chemists Charles W. Blessin, George E. Inglett, William J. Garcia, Wilbur J. Deatherage and James F. Cavins did the research on converting this meal into a new food. They point out that corn germ flour contains a higher level of all amino acids essential to man than is called for in the Food and Agricultural Organization's provisional pattern of 1965. □

*Left: Mr. Garcia (left) and Mr. Blessin discuss their research with corn germ flour. The jars in foreground contain (from left) whole yellow dent field corn, dry miller corn germ fraction, and defatted corn germ flour (1272A1546-2). Right: Mr. Deatherage records data on freshly baked cookies made with germ-wheat flour blend. Cookies must meet standards of width and thickness to be used as a method of evaluation (1272A1546-2).*





## LIFE HISTORY OF THE LIVER FLUKE, *FASCIOLA HEPATICA* (Larval stages greatly enlarged)



When the eggs of the liver fluke hatch, they liberate larva called miracidium. The miracidium is ciliated and swims about in the water until it comes in contact with a suitable snail, into which it bores. Then it changes a number of times, finally becoming what is known as a redia. Large numbers of minute stages, shaped like tadpoles and known as cercariae, are produced in the redia. These eventually escape from the snail, swim about, and become encysted on grass or other vegetation.

## Breaking the liver fluke cycle

THE COMPLEX LIFE STYLE of the common liver fluke, *Fasciola hepatica*, may be the key to its eventual control by immunization.

Rex W. Allen, ARS-cooperating scientist, Las Cruces, N. Mex., says that ARS-sponsored research in Yugoslavia represents some of the first specific information developed on the nature of the antibody response to higher parasitic forms. "These parasites," he says, "are very difficult to combat by immunization procedures, and, in the case of the liver fluke, no antigens suitable for vaccination have been developed."

The common liver fluke causes extensive losses in cattle and sheep production in many areas of the world, including the United States. It is occasionally found in the human liver, where it may cause dangerous symptoms. The most obvious injury to cattle

is to the liver, where the parasites cause irritation of the bile ducts, enlargement and thickening of the walls, and fibrosis of the liver tissue. In some cases, the disease in both cattle and sheep is also characterized by anemia and general debilitation.

The life cycle of *F. hepatica* comes full circle when it penetrates the bile ducts in the liver of its host. Fertilized fluke eggs then pass through the gut and fall with the feces to the ground where the eggs hatch into miracidium larvae. The miracidia seek certain snail species of the family Lymnaeidae as intermediate hosts. During the next 50 to 80 days the flukes change into various forms within the snail and eventually escape as free swimming cercarial larvae that encyst on vegetation, which may be eaten by the flukes' host. A single fluke egg may yield

10,000 cercariae; a single adult fluke produces many tens of thousands of eggs.

"In studying this cycle," Dr. Allen, research zoologist, says, "the Yugoslav scientists used a variety of immunochemical and immunobiological methods to provide new information about the organ sites in the developing parasite where the greatest antigenic activity occurs. Additionally, we now know the time in the developmental cycle of the parasite when different antigens are most active."

Antigens are substances that cause the development of antibodies. Knowledge of antigen sites and the time of their greatest activity in the offending organism is important in the development of an immunizing vaccine.

The Yugoslav principal investigator, Dr. Kosta Cuperlovic, found that the



antigenic arrangement necessary to bring about an antibody reaction is completed the moment the genital organs of the fluke are developed. He says the sites of the greatest antigenic activity in the fluke are in both the reproductive organs, which develop last, and in the digestive organs.

However, as both Dr. Allen and Dr. Cuperlovic point out, antigen-antibody reaction may have no real or continuing effect on functional immunity. Therefore, future work points to further refinement of the fractions of antigenic material to find the precise material that will be antigenic and at the same time function in a vaccination procedure.

Also, further work about the radiobiological effects on the liver fluke needs to be done. For example, the Yugoslavs found that flukes rendered sexually sterile through irradiation with X-rays during an immature developmental stage retained the capacity to stimulate an immune response when used to infect experimental animals. These findings suggest the possibility of safe biological control of liver flukes through induction of immunity in live-stock by infection with irradiated, immature flukes prior to grazing in fluke-infested areas.

The present findings also point to the need for further research on:

- "protective" antigens which could stimulate production of protective antibodies;
- non-protective antigens that could be applied in immunodiagnosis of liver fluke infection;
- the role of immunoglobulins in infection with liver fluke; and
- amino acid composition of the antigens, for a better understanding of their protein structure and behavior.

The Yugoslav project was conducted under the provisions of Public Law 480 at the Institute for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun. □

## Pollen cakes save the bees

CORN GROWERS are aware of the destructive effects of the European corn borer and the corn earworm. One way to fight these pests is to aerially spray insecticide on the crop. But what about the effect of insecticide on beneficial insects like honey bees?

For two years, ARS entomologist Floyd E. Moeller, in cooperation with the Wisconsin Agricultural Experiment Station, Madison, worked with colonies of bees whose major source of available pollen was sweet corn. When the bees were supplied with cakes of clover pollen in their hives they gathered much less corn pollen. As a result, only a few bees died from insecticide poisoning during the critical period when corn fields were aerially sprayed with carbaryl and 2-chloro-1-(2,4,5-trichlorophenyl) vinyl dimethyl phosphate.

Since bees do not prefer corn pollen as a food source, it seemed feasible to divert them with a more attractive pollen. Moreover, the

bees were not needed in the fields because corn is wind pollinated.

The bees gathered some corn pollen, however, in addition to that provided in pollen cakes. To measure what effect corn pollen had on bee mortality pollen traps were placed in all hive entrances. When cakes consisting only of pollen with enough sugar and water to make a patty were furnished, only 4.3 percent of the pollen gathered was from corn. When the pollen cakes were three-fourths soybean flour, Dr. Moeller found the bees collected 40 percent of their additional pollen from corn. Without pollen cakes, 53.4 percent was from corn.

Records were kept on the number of dead bees cleared daily from in front of the hives during the aerial spraying period. Pollen traps alone reduced mortality by removing some of the contaminated pollen. The combination of pollen cakes in the hive and a pollen trap on the hive entrance essentially prevented mortality. □



## Morrison lecture . . . Humanizing the earth

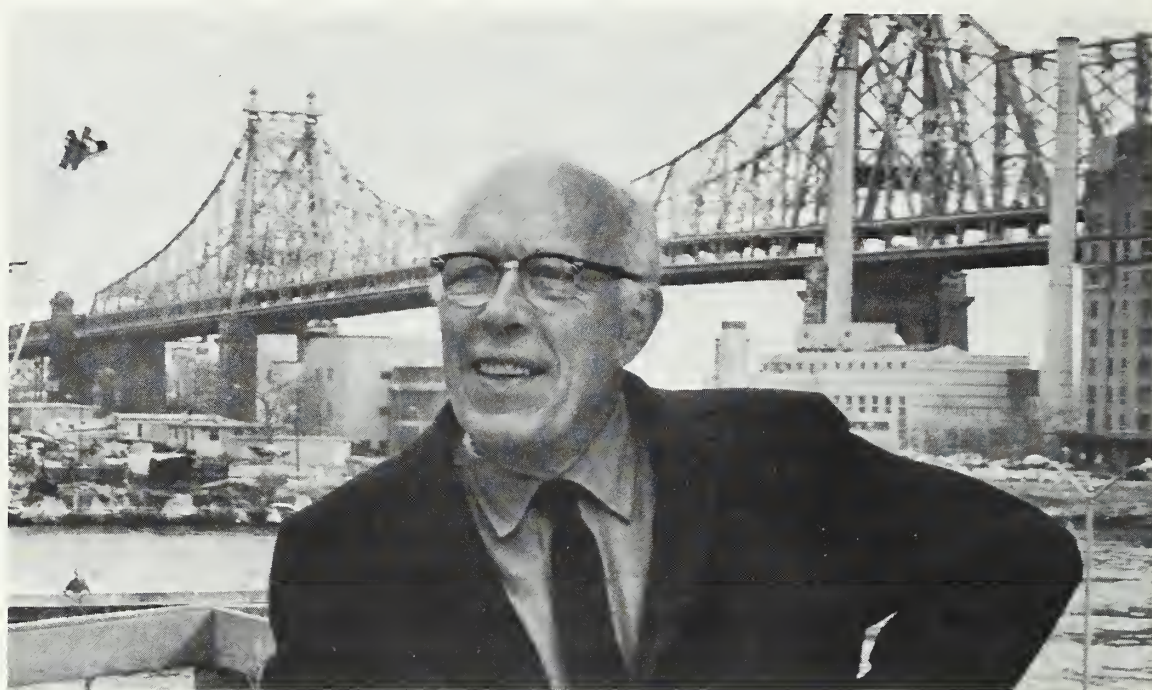
NATURE is incapable, by itself, of fully expressing the diversified potentialities of the earth. But "the human use of natural resources and of technology is compatible with ecological health and can, indeed, bring out potentialities of the earth which remain unexpressed in the state of wilderness."

These are the optimistic views of ecologist Rene Jules Dubos who presented the fifth annual Morrison Memorial Lecture. Dr. Dubos, a French-born American, is a medical microbiologist, experimental pathologist, humanist, and professor emeritus of The Rockefeller University, New York, N.Y.

In his lecture, entitled "Humanizing the Earth," Dr. Dubos contended that man, using knowledge and reason, can improve on nature. "Of course," he said, "many of man's interventions into nature have been catastrophic." History is replete with ecological disasters caused by agricultural and industrial mismanagement, disease, warfare, civil strife, and overpopulation.

Dr. Dubos said, however, that the wisdom of nature is often shortsighted, as is illustrated by the many disasters that repeatedly affect plants and animals in their undisturbed native habitats. To prove his point, Dr. Dubos cited not only major natural catastrophes such as droughts, hurricanes, and earthquakes, but also periodic population crashes such as the mass deaths of lemmings, muskrats, and rabbits. Just as it is erroneous to state that nature, left to its own devices, recycles naturally—peat, coal, oil are *failure* examples—so is it erroneous to claim that nature has no junk yards. "The science of paleontology is built on them."

Given the shortcomings of the ecological practices by both man and nature, Dr. Dubos, nevertheless, saw solutions. "Now that so much of the world has been humanized, environ-



*Dr. Dubos feels that an initial awareness of our environmental problem is the kernel of its solution. For example, we must learn to assemble our wastes efficiently, classify them, find ways to recycle and reuse them. In America, our major crisis today is the disposal of solid wastes, for "we cannot continue to dump solid wastes into the sea" (0572X666-5).*

mental health depends to a very large extent on human care." For example, mankind must learn to recycle its wastes, must efficiently harness new forms of energy as the world supply of fossil fuels is exhausted, must learn to manage the earth's resources economically, Dr. Dubos said.

"Humanizing the earth," he said, "implies more than transforming the wilderness into agricultural lands, pleasure grounds, and healthy areas suitable for the growth of civilization. It also means preserving the kinds of wilderness where man can experience mysteries transcending his daily life and where man can recapture direct awareness of the cosmic forces from which he emerged."

The 1972 Morrison Memorial Lecture was given in Washington, D.C., at the 139th annual meeting of the American Association for the Advancement of Science. This lecture series is sponsored by ARS in honor of Benjamin Y. Morrison, first director of the National Arboretum. □

Forty-four years ago Dr. Dubos first demonstrated the feasibility of obtaining disease germ killers from microbes; in 1929 he isolated a microbe enzyme that could destroy the protective capsule of pneumococcus, the germ responsible for lobar pneumonia. Ten years later he discovered tyrothricin, precursor of gramicidin and tyrocidine, both powerful antibiotics. Medical recognition of Dr. Dubos' work led to the practical use of such drugs as penicillin and streptomycin.

Among Dr. Dubos' more recent achievements have been his contributions to the study of tuberculosis; he developed a rapid method for growing tubercle bacilli in submerged cultures. His work has also included investigations of the mechanisms of acquired immunity as well as natural susceptibility and resistance to infection.

Dr. Dubos has also been concerned with the effects of environmental forces—physicochemical, biological, and social—on human life.



## Drying raisins faster

TWO new processes for treating grapes promise to reduce the drying time required for raisin production.

Presently, once the grape stems have been cut for harvesting, growers are at the mercy of the weather for 10 to 14 days while the grapes sun-dry in the fields. These new processes should also produce better quality raisins because the growers will gain flexibility with harvest times. For instance, they will be able to pick the grapes later in the season when at their sweetest.

Both processes use an oleic acid or oleic ester dip. These chemicals modify the wax structure on the grape skin so that moisture leaves the fruit faster.

In the first method, laborers move through the rows of grapes, cutting the canes. The grapes then hang on the vines for about 5 days allowing the stems to dry. This drying causes the cap stems on each grape to remain attached during harvesting, thus preventing sugar loss.

The grapes are then picked by a mechanical harvester developed for picking wine grapes. This harvester straddles a row of grapes, its vibrating fingers dislodging the berries which drop onto a conveyor. The fruit then moves along these belts to bulk storage bins. The bins are moved to a processing plant where the grapes are dipped in an oleate solution, spread on trays, and then dehydrated to about 13 percent moisture in a forced-air drying chamber. The oleate treatment dehydrates the grapes to raisins in about 12 hours. Conventional sun-drying takes from 10 to 14 days.

In the second method, the canes are also cut and the grape bunches remain entangled on the trellises. A few hours later, a self-propelled sprayer, equipped with troughs to catch any excess oleate spray, moves through the field saturating the surface of the fruit with a suspension of oleate in water. The grapes

are allowed to hang on the trellises until the fruit dries to about 13 percent moisture (about 1 week). Then the grapes are mechanically harvested. The entire process eliminates about 6 days drying time.

Raisins from oleate-treated grapes are light brown compared to the blue-black of regular sun-dried grapes. Their appearance is similar to some imported raisins. If the raisins receive consumer acceptance, the new drying processes should become popular with growers.

Chemists Harold R. Bolin and Glenn Fuller of ARS's Western regional research laboratory, Berkeley, Calif., and Professor Vincent Petrucci of California State University at Fresno cooperated in this research.

## Maple sirup from West Virginia?

WEST VIRGINIA has what it takes for a thriving maple sirup industry—the trees, the climate, the labor, and the market.

Scientists have been working for years to develop modern and more efficient ways of harvesting maple sap and evaporating it to sirup. This work, done at the Eastern regional research laboratory, Philadelphia, Pa., has revolutionized the industry and opened up new possibilities for its expansion to other areas.

In West Virginia, for example, sugar maple trees grow in dense stands. A little tapping is done, but the few thousand gallons of sirup produced hardly show up in the statistics. To find out if maple sugaring could provide additional income for rural West Virginians, ARS contracted with West Virginia State University to survey the State. Extension forester William E. Kidd, Jr., identified areas where large numbers of trees are clustered closely

together, where fuel and labor are available, and where a large potential market is nearby.

There are three areas in the State where 80 to 100 taps to the acre could be supported. This would be enough to establish profitable sirupmaking enterprises, since producers could net \$40–\$125 per acre for about six to eight weeks' work.

Profit can be made by harvesting sap as well as by making sirup. A landowner could tap his own trees; others could lease trees for tapping from private lands or public forests. The survey indicated widespread willingness of owners to allow their trees to be tapped.

For making sirup, centralized evaporation plants could be established. Sap harvesters who cannot afford the investment required to go into sirup-making could sell their sap to such plants for processing.

For a maple sirup industry in West Virginia—and other favorably endowed regions—many modern developments advanced by the Philadelphia laboratory are available. These include sap collection with plastic tubing that eliminates constant emptying of sap buckets; a method of sanitizing tap-holes for longer sap runs; improved sanitation procedures that permit longer storage of the sap before making it into sirup; and modern equipment and techniques for processing sap to sirup.

## Quick test for acid

A FASTER METHOD for measuring the concentration of aconitic acid in plant material may help both plant and animal scientists move closer to solving problems caused by the acid.

Ralph B. Clark, ARS chemist at the Ohio Agricultural Research and Development Center, Wooster, Ohio, devel-





## AGRISEARCH NOTES

oped the new test in the course of his work on corn.

Aconitic acid is related to at least two serious problems of agriculture, grass tetany in cattle and sheep, and a bitter taste in sorghum, sugar beet, and sugarcane juices.

Grass tetany, an often fatal poisoning problem of cattle and sheep, is widespread in areas where lush growths of spring and fall grasses and small grains are utilized for forage. The condition is due to a magnesium deficiency, and is accentuated by high levels of potassium and total nitrogen in the forage. High levels of aconitic acid may also be related to grass tetany.

Animals affected by grass tetany poisoning first show unusual excitement, lack of coordination, and loss of appetite. Unless treated, staggering, muscular contraction, coma, and death follow. Affected cattle usually recover if they receive an injection of calcium-magnesium gluconate in the first few hours after symptoms appear. Chances for recovery are slight if treatment is delayed 8 to 12 hours (AGR.RES., July 1969, p. 7).

There may be some potential for use of the quick aconitic acid test, along with other tests for magnesium and calcium, to help diagnose grass tetany and evaluate pasture grass before turning livestock onto the pasture.

In the case of sorghum, sugar beets, and sugarcane, high aconitic acid levels are related to a bitter taste in the juices. This requires several additional and expensive refining steps to remove the acid.

There are two forms of aconitic acid.

The *cis* form occurs in almost all plants while the *trans* form of the acid occurs mostly in grass type plants. Cis-aconitic acid is known to play a role in the citric acid cycle in plant metabolism. The function of trans-aconitic acid in plants is unknown.

The procedure Dr. Clark has developed saves much of the tedious time and labor involved in preparation of the plant extracts for evaluation.

The test method consists of taking a small sample of plant extract, putting it in a reaction tube, and keeping it cold in an ice bath while acetic anhydride and pyridine are added. A characteristic yellow color immediately forms that can be measured quickly in a spectrophotometer.

## Early weaning/more calves

EARLY WEANING of beef cattle may be the answer to obtaining one calf per cow every 12 months in certain intensive management systems.

Cattlemen who carry barren cows longer than necessary are losing money with each passing day. Ideally, the majority of the cows should conceive early in the breeding season to maintain high profit margins. Yet, getting a cow with calf during the first 21 days of the breeding season can be a problem in 2- and 3-year-old and late-calving mature cows.

ARS physiologist Danny B. Laster and nutritionist Hudson A. Glimp, U.S. Animal Research Center, Clay Center,

Nebr., conducted a study with 300 cows to determine if weaning their calves early would decrease the interval from calving to conception.

One-third of the calves were weaned 1 week before the beginning of the breeding season at an average age of 8 weeks. These calves were placed in drylot and fed a pelleted ration the first 2 months. Calves remaining with the cows were creep-fed oats.

At the end of a 42-day artificial breeding period, there were 15 percent more pregnant cows in the early-weaned group than in the cows nursing calves. Also, in the early-weaned group, 12 percent more of the cows conceived during the first 21 days of the breeding period. The early-weaned calves gained slightly more than those nursing their dams.

The scientists now need to determine if an extra 15 calves per 100 cows is sufficient to offset the cost of feeding and managing the early-weaned calves.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

